

General Game Playing with Stochastic CSP - one page abstract

Citation for published version (APA):

Piette, E., Koriche, F., Lagrue, S., & Tabary, S. (2015). General Game Playing with Stochastic CSP - one page abstract. In *The International Conference on Principles and Practice of Constraint Programming: (CP'15)*

Document status and date:

Published: 01/09/2015

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

www.umlib.nl/taverne-license

Take down policy

If you believe that this document breaches copyright please contact us at:

repository@maastrichtuniversity.nl

providing details and we will investigate your claim.

General Game Playing with Stochastic CSP

Frédéric Koriche, Sylvain Lagrue, Éric Piette, and Sébastien Tabary

Université Lille-Nord de France CRIL - CNRS UMR 8188 Artois, F-62307 Lens

{koriche, lagrue, epiette, tabary}@cril.fr

<http://www.cril.univ-artois.fr/~{koriche, lagrue, epiette, tabary}>

Abstract. ¹ The aim of *General Game Playing* (GGP) is to devise game playing algorithms which are not dedicated to a particular strategic game, but are general enough to effectively play a wide variety of games. A tournament is held every year by AAAI, in which artificial game players are supplied the rules of arbitrary new games and, without human intervention, have to play these game optimally. Games rules are described in a declarative representation language, called GDL for *Game Description Language*. The latest version of this language is expressive enough to describe finite multi-player games with uncertain and incomplete information. GGP algorithms include, among others, answer set programming methods, automated construction of evaluation functions, and Monte-Carlo methods such as Upper Confidence bounds for Trees (UCT). Beyond its play value, GGP offers a rigorous setting for modeling and analyzing sequential decision-making algorithms in multi-agent environments.

By providing a declarative approach for representing and solving combinatorial problems, Constraint Programming appears as a promising technology to address the GGP challenge. Currently, several constraint-based formalisms have already been proposed to model and solve games; they include notably *Quantified CSP*, *Strategic CSP* and *Constraint Games*. Most of these formalisms are, however, restricted to deterministic, perfect information games: during each round of the game, players have full access to the current state and their actions have deterministic effects. This paper focuses on *stochastic* games, with chance events, using the framework of stochastic constraint networks.

More precisely, we study a fragment of the Stochastic Constraint Satisfaction Problem (SCSP), that captures GDL games with uncertain (but complete) information. Interestingly, the SCSP for this class of games can be decomposed into a sequence of μ SCSPs (a.k.a one-stage stochastic constraint satisfaction problems). Based on this decomposition, we propose a sequential decision-making algorithm, MAC-UCB, that combines the MAC algorithm (*Maintaining Arc Consistency*) for solving each μ SCSP, and the multi-armed bandits *Upper Confidence Bound* (UCB) method for approximating the expected utility of strategies. We show that in practice MAC-UCB significantly outperforms (the multi-player version of) UCT, which is the state-of-the-art GGP algorithm for stochastic games. MAC-UCB also dominates FC-UCB, a variant where MAC is replaced with the Forward Checking (FC) algorithm. Such conclusions are drawn from comparing the performance of these algorithms, using extensive experiments (about 1,350,000 face-offs) over a wide range of GDL games.

¹ This paper has been published in Constraints 21(1), the Journal Fast Track issue of CP'15.